

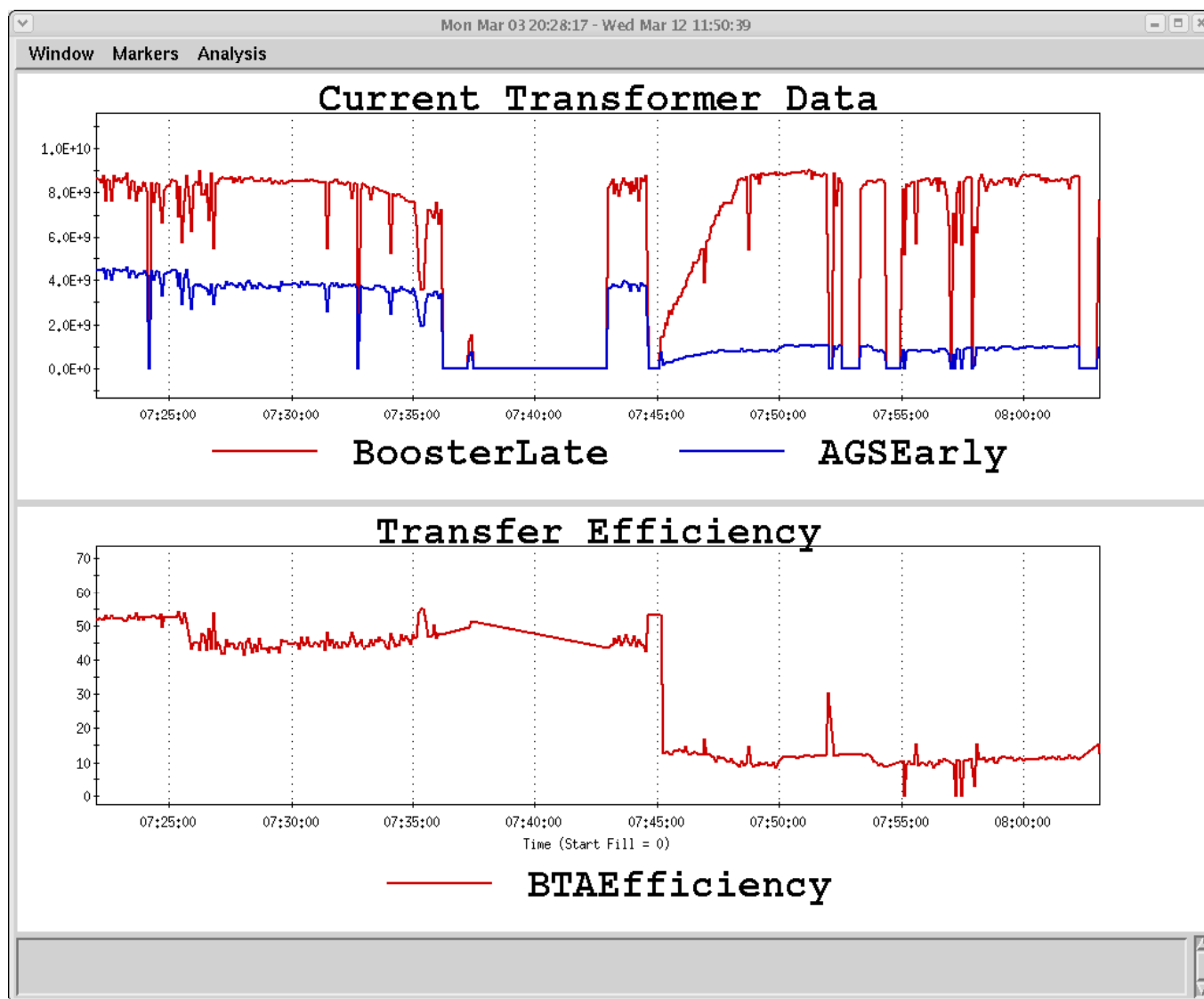
Data Correlation in RHIC Injectors

John T. Morris May 20, 2008

- AGS cycles
- Correlation by AGS Cycle in Gpm and Loggers
- About time stamps
- Time stamps in Gpm and Loggers
- Recent/planned work

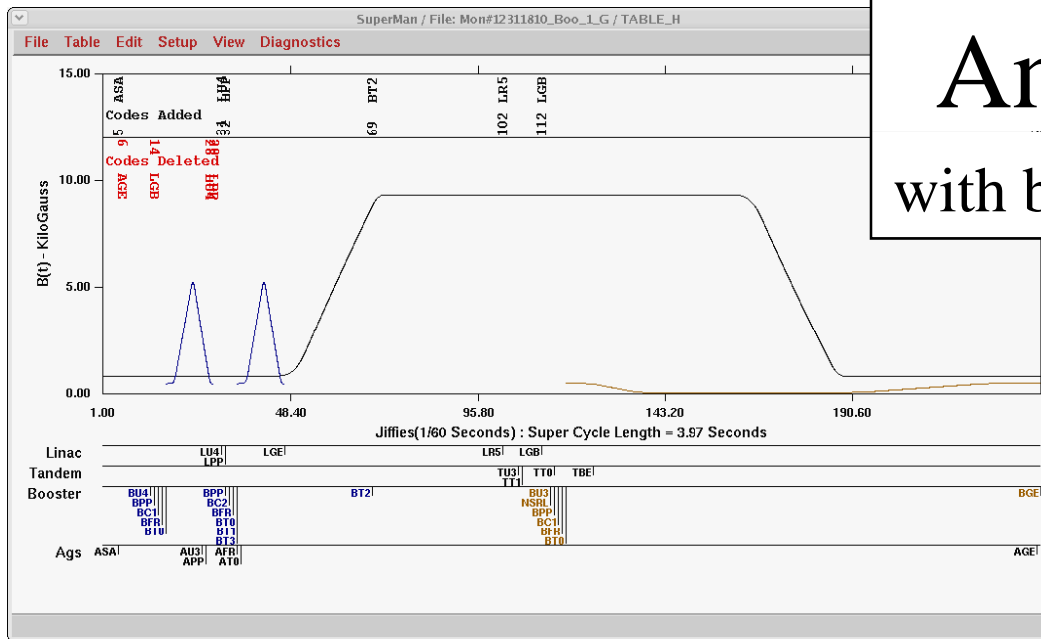
Not covered

- *Correlation by Acq Time Period*
- *PPM (but it doesn't really change things)*
- *Retrieving logged data*

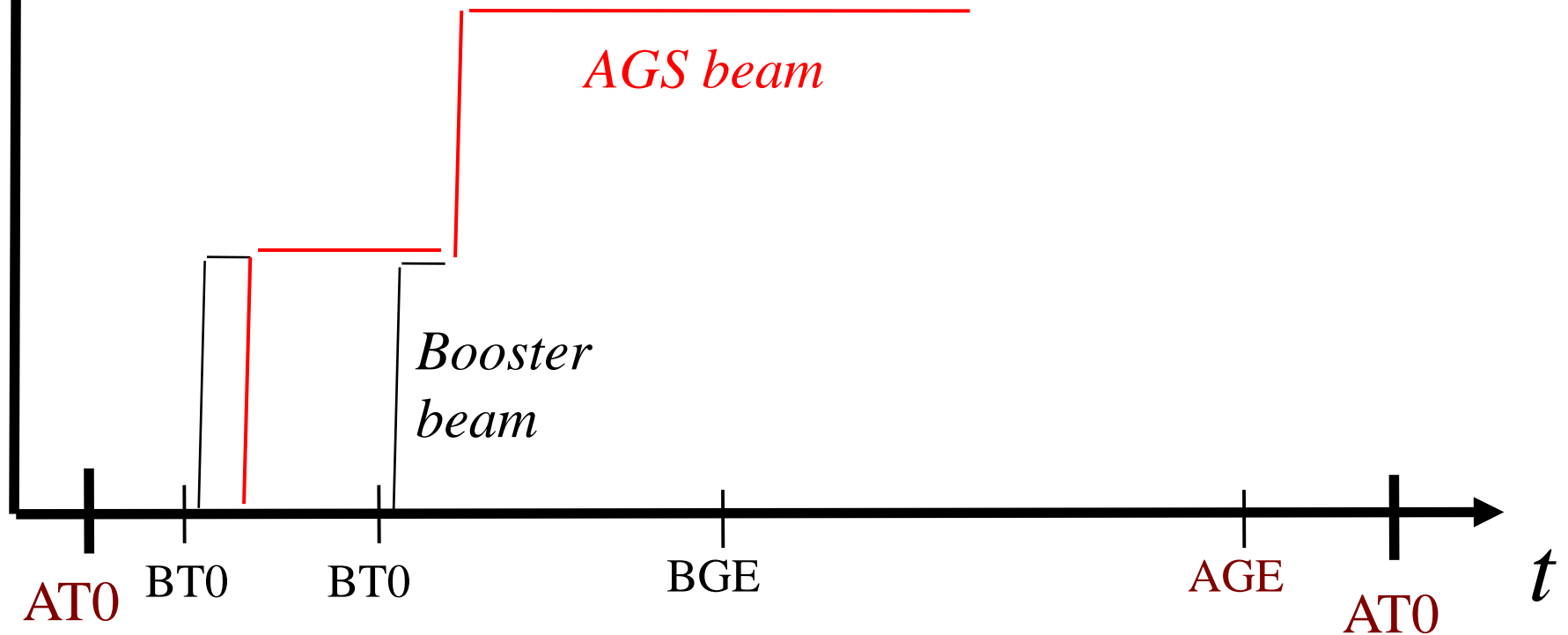


An AGS Cycle

with basic supercycle events

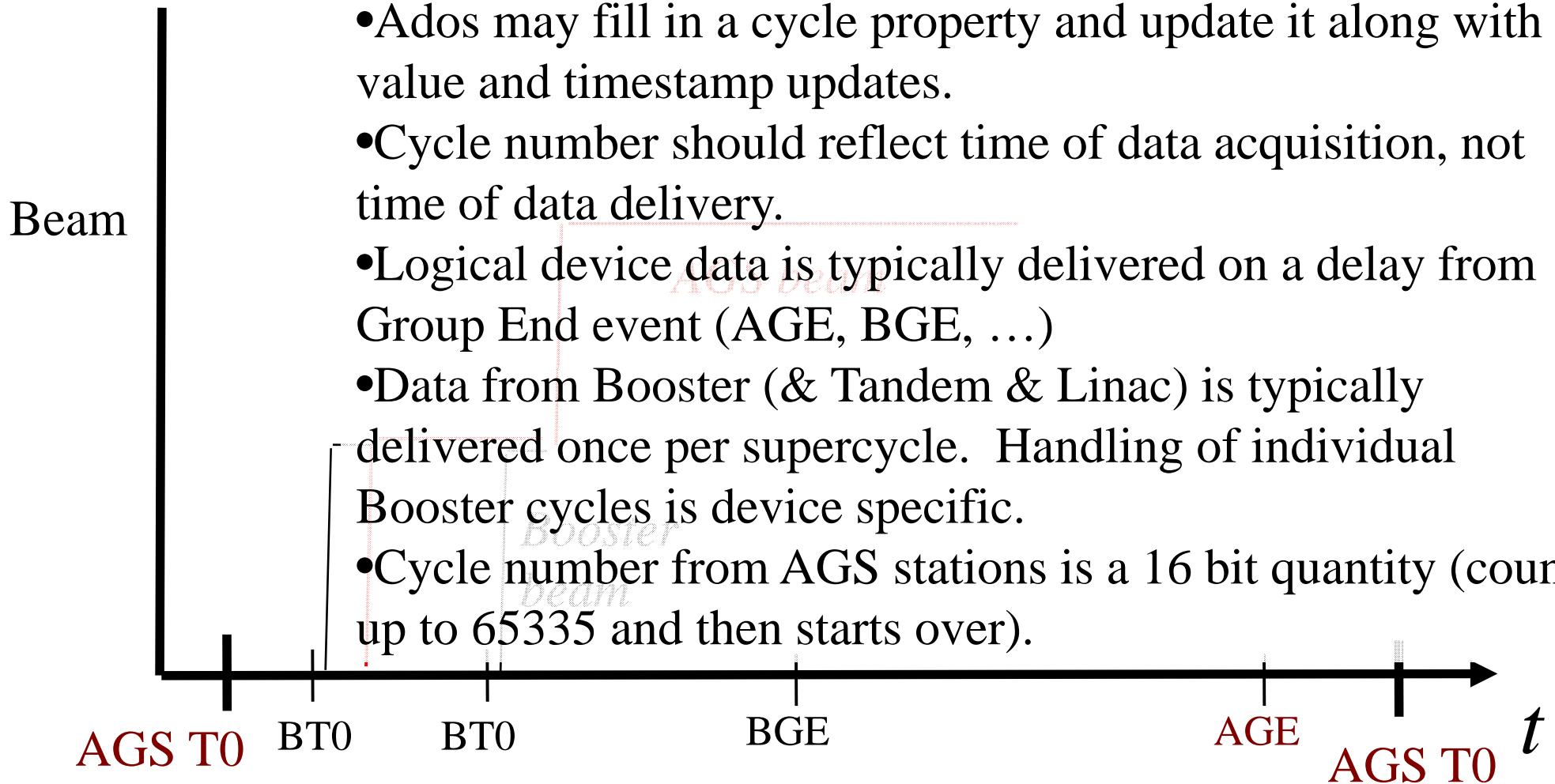


Beam



AGS Cycle Facts

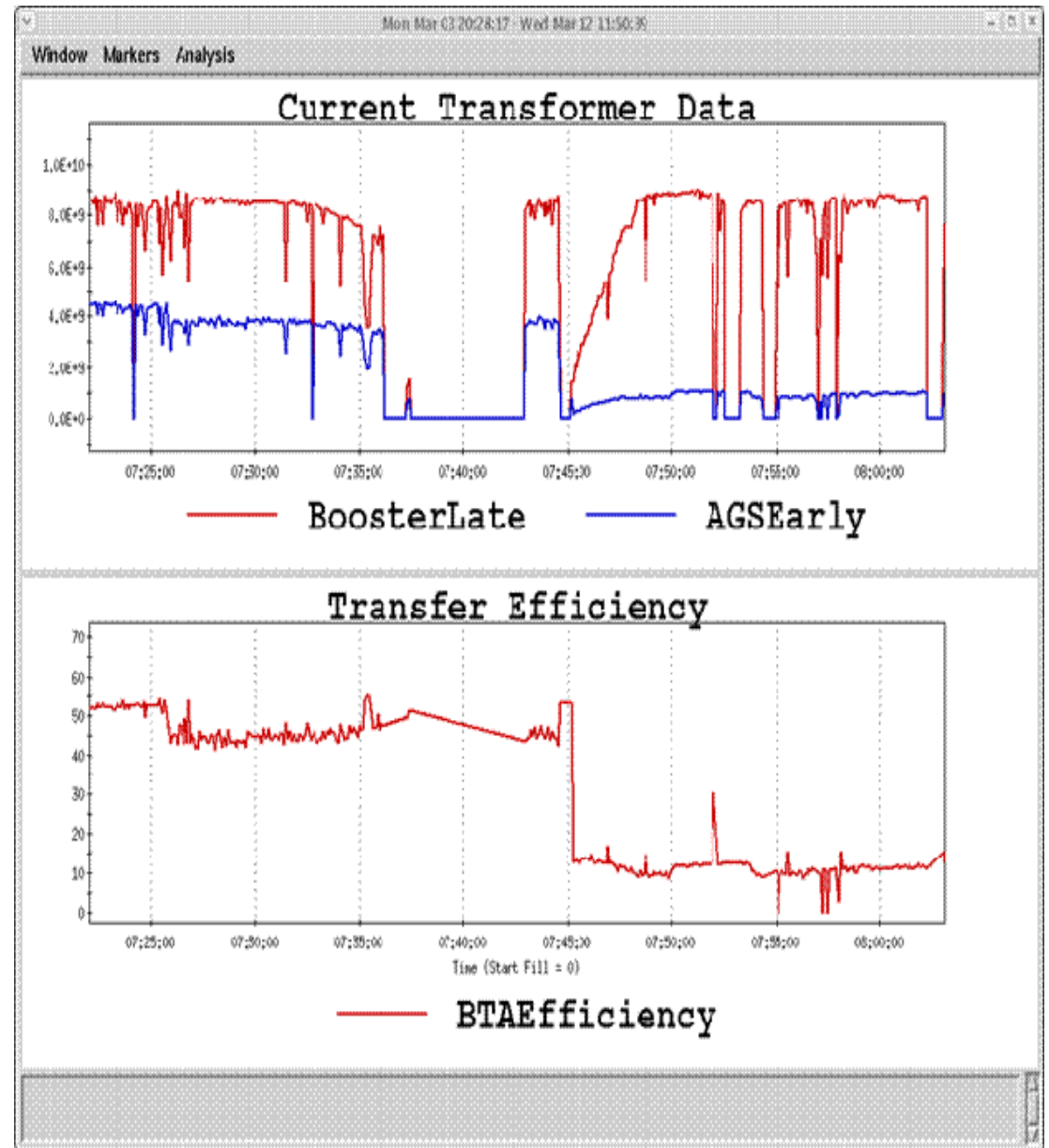
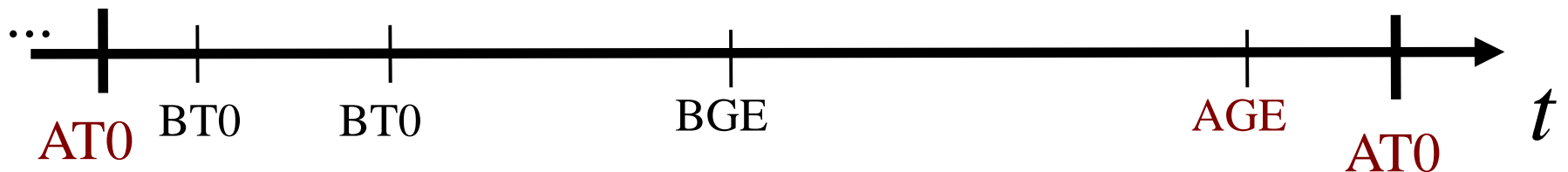
- There is 1 AGS cycle per supercycle
- AGS cycle number changes at AGS T0
- AGS T0 events happen even when AGS is not running.
- AGS cycle number is available in an RTDL frame
- Logical device data (from AGS stations) is delivered with an AGS cycle number in message
- Ados may fill in a cycle property and update it along with value and timestamp updates.
- Cycle number should reflect time of data acquisition, not time of data delivery.
- Logical device data is typically delivered on a delay from Group End event (AGE, BGE, ...)
- Data from Booster (& Tandem & Linac) is typically delivered once per supercycle. Handling of individual Booster cycles is device specific.
- Cycle number from AGS stations is a 16 bit quantity (counts up to 65335 and then starts over).



Gpm/Logger

Correlation by AGS Cycle

- An AGS cycle number is associated with each piece of data
- Data with the same cycle number is grouped together for
 - cell calculations
 - snapshot displays
 - correlation displays
 - ...



How do Gpm/Logger applications associate AGS cycle numbers with data?

Logical device data?

Cycle number is
delivered with data.

Ado data with cycle property?

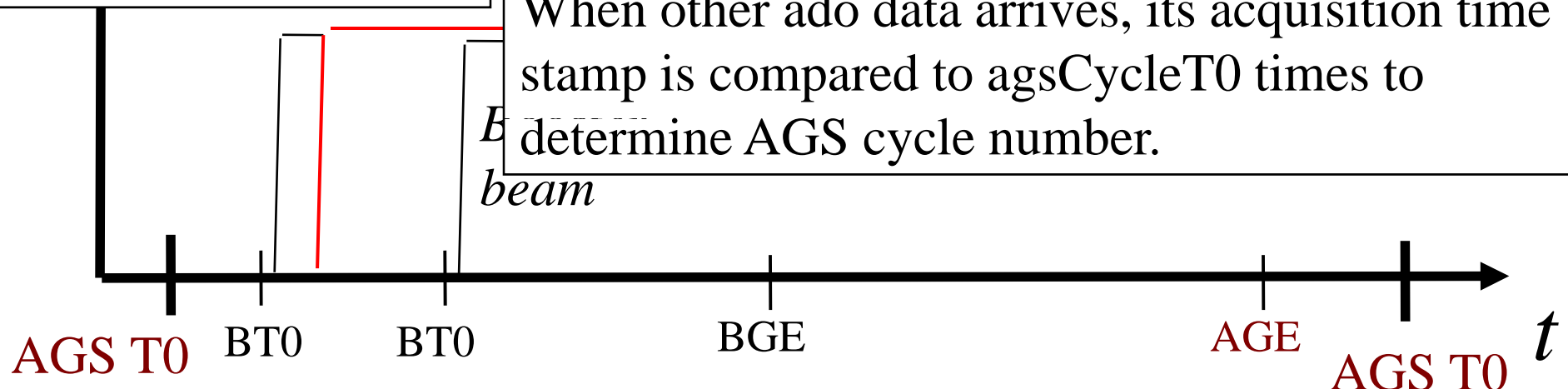
Cycle num & time stamp
delivered with data.

Ado data without cycle property?

Cycle number is deduced based on time stamp.

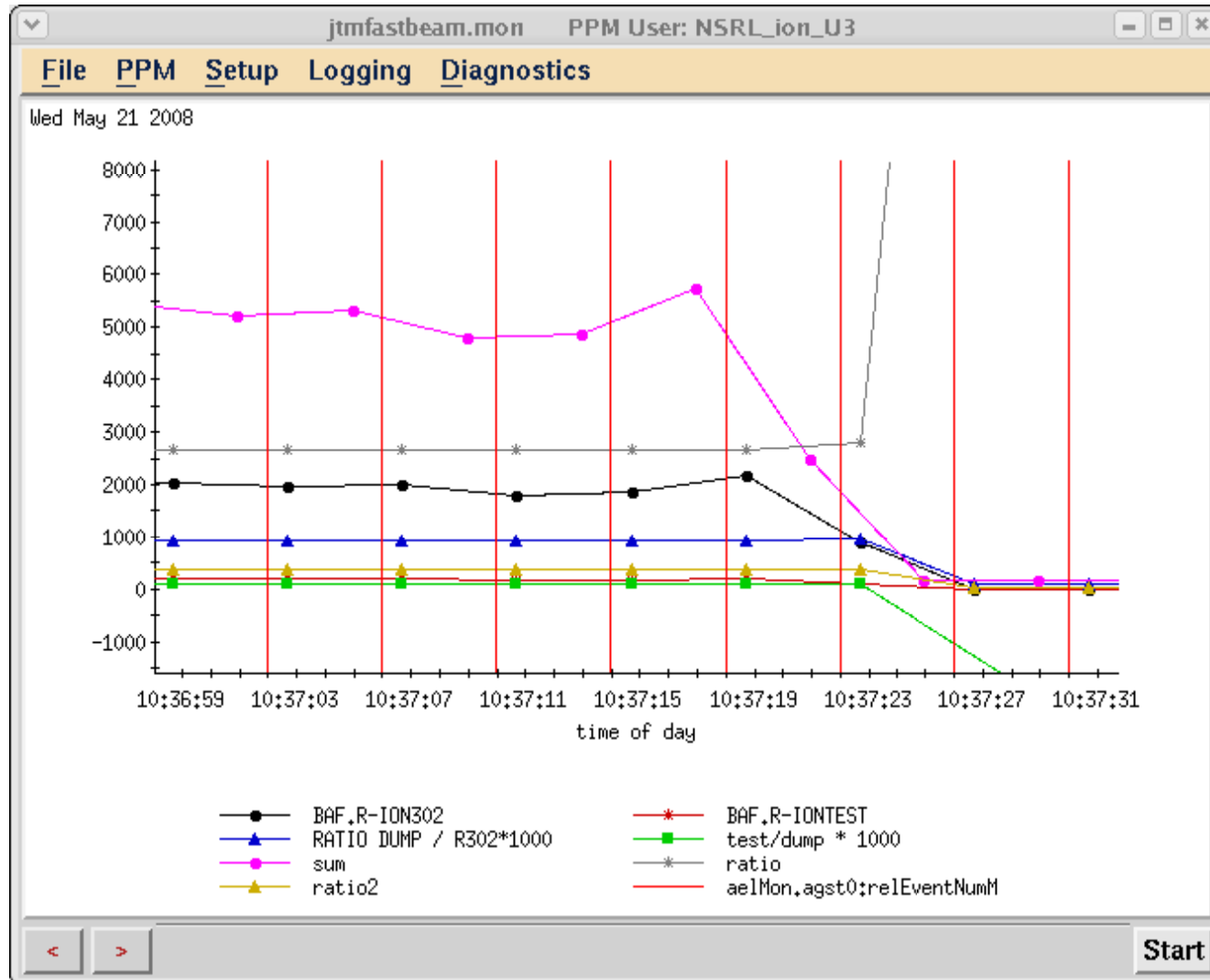
‘AGS cycle marker’ data is received at each AT0
with new cycle number AND acq time stamp.
(available from *agsCycleT0* param in utility
module *ados* on all FECs).

When other ado data arrives, its acquisition time
stamp is compared to *agsCycleT0* times to
determine AGS cycle number.



Time Stamps

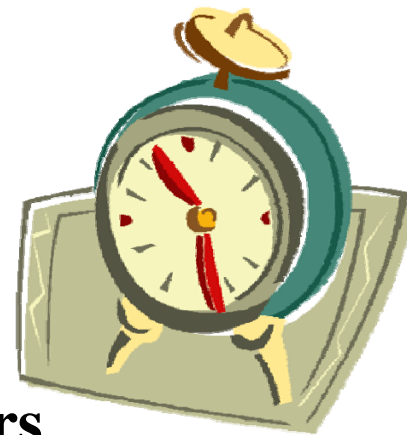
Even if you correlate data by AGS cycle number, Gpm/Logger software needs accurate time stamps to...



- Properly place data on strip charts
- Store with logged data for proper display in LogView or offline analysis
- Deduce cycle numbers for data that does not come with a cycle number attached

About Time Stamps

What time is it? It depends on who you ask.



Console and Server Computers

- System times are kept in sync with Network Time Protocol (ntp)
- System times should agree to within one second (probably much better than that)
- RTDL master FECs are also kept in sync with ntp

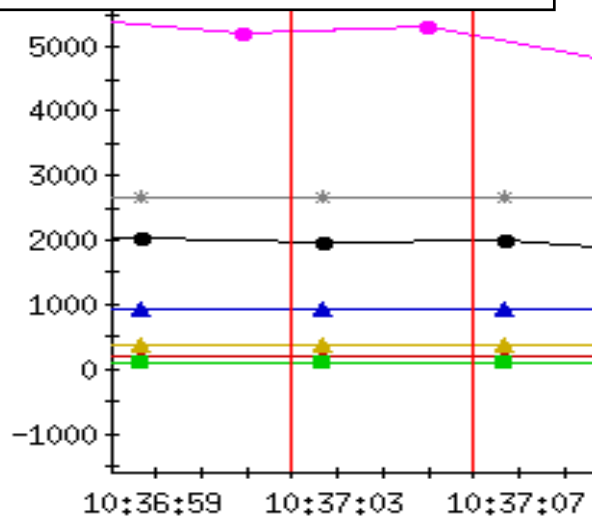
Front End Computers

- Time is distributed on RTDL
- RTDL time guaranteed to agree on all FECs with 1/720 second resolution
- RTDL time (RHIC & injector) 'ticks' in sync with 60Hz line frequency
- RTDL time may 'drift away' from ntp time (up to 1 sec per hour)
- RTDL time is put in sync with ntp time at newfill and updatetime events

How do Gpm/Logger applications associate acquisition time stamps with data?

Ado measurement data with time stamps

Time stamps come with the data.



—●— BAF_R-ION302
—▲— RATIO DUMP / R
—●— sum
—▲— ratio2

—*— ratio
— — aelMon.agst0:relEventNumM

1. Logical device data
2. Ado settings
3. Ado meas data without time stamps

Software constructs time stamps based on arrival time.

An adjustment is made to put time in RTDL time frame.

Offset between local system time and RTDL time is obtained from

- agsCycleT0 parameter updates
- or
- periodic polling to get FEC RTDL time

Start

What could go wrong?

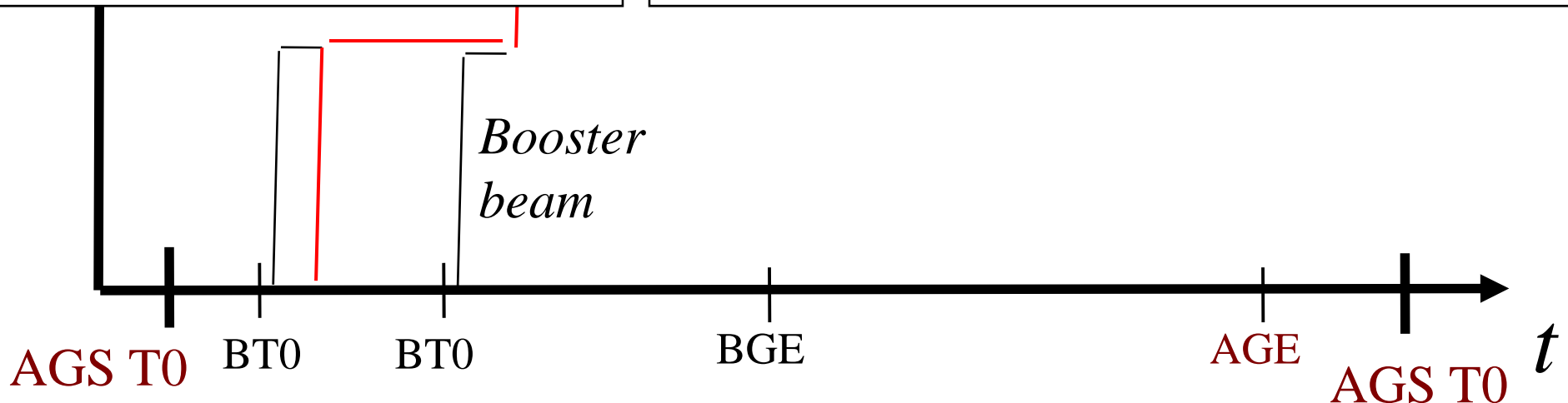
Problem: Data does not come with time/cycle stamps AND it arrives late (i.e. after the next cycle has started)

To avoid this: Reduce dependence on arrival time. Apply time/cycle stamps at data source (FEC / manager / cdevServer).

Problem: Incorrect time/cycle stamp applied at source of data.

Example: Scalers for current xfmrs. Due to misconfiguration of triggers, scaler registers were read by FEC before scaler hardware update was triggered. Stale data from previous cycle was reported.

To avoid this: System engineering,
attention to configuration.



Recent changes

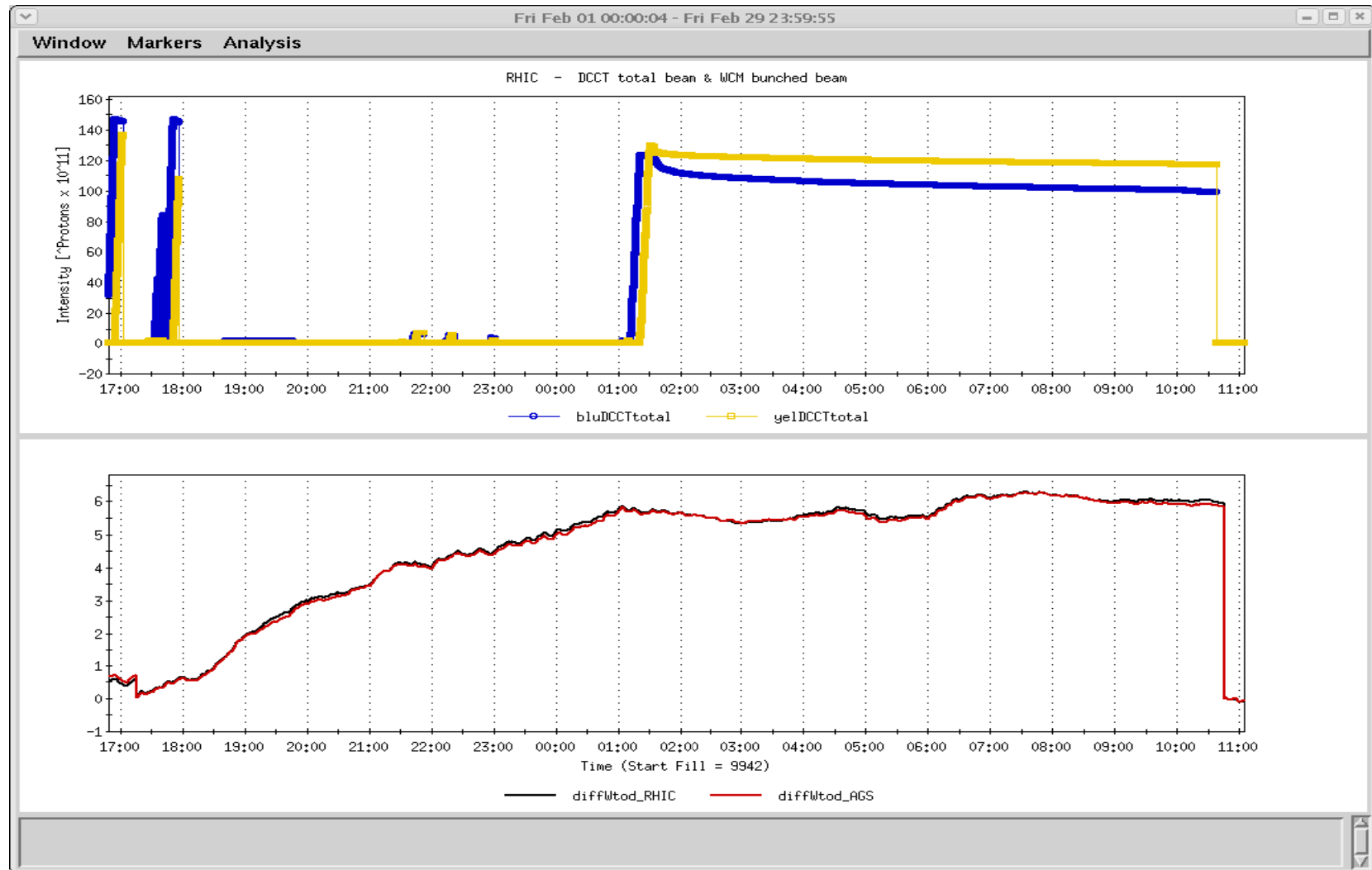
- AGS stations read cycle numbers from RTDL.
 - Cycle property added to more injector ados (e.g. NSRL scalars in 958)
 - Gpm/Loggers now use util ados as cycle markers.
- Since these cycle markers have acq time stamps, we are less vulnerable to problems due to delivery delays.
- Time stamp correction to FEC RTDL time frame is consistently applied.

Remaining Work/Issues

- Make cycle property a regular part of ado infrastructure in injectors.
- Ensure proper time/cycle stamps are applied to manager/cdevServer data.
- Store AGS cycle number in logs of injector data.
- Improve/simplify assignment of time stamps for array elements.
- Provide standard methods of dealing with multicycle (e.g. Booster) data.
- Deal with data that arrives more quickly than the defined correlation period (e.g. data that may arrive once per EBIS cycle)
- Make Gpm/Logger correlation techniques available to other apps.
- Consider correlation with data that is not in RTDL time frame (e.g. set history data, AlarmReceiver data)
- Prepare to support 24 bit AGS cycle number in client side software.

Extra slides follow...

Time Drift: difference between RTDL and ntp time during one long fill (bottom graph)



Time Drift: difference between RTDL and ntp time during one month (February 2008)

